PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2004/016398	21.05.2004	21.05.2002

International Patent Classification (IPC) or both national classification and IPC
G06F17/30, G06F15/78

Applicant
WASHINGTON UNIVERSITY

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2004/016398

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. II Priority

1. ☒ The following document has not been furnished:

   ☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

   ☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

   Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. ☐ It has not been possible to consider the validity of the priority claim because a copy of the priority document was not available to the ISA at the time that the search was conducted (Rule 17.1). This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

4. Additional observations, if necessary:

   see separate sheet

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has:

   ☒ paid additional fees.

   ☐ paid additional fees under protest.

   ☐ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with

   ☒ not complied with for the following reasons:

   see separate sheet

4. Consequently, this report has been established in respect of the following parts of the international application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1-15, 17-28, 65-72

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	3-14,18-64,65-72,86-97
	No:	Claims	1,2,15,17
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-15,17-72,86-97
Industrial applicability (IA)	Yes:	Claims	1-15,17-72,86-97
	No:	Claims	

2. Citations and explanations

see separate sheet

The following documents are referred to in this communication:

D1 : HOLLAAR L A: "HARDWARE SYSTEMS FOR TEXT INFORMATION RETRIEVAL" PROCEEDINGS OF THE ANNUAL INTERNATIONAL ACM SIGIR CONFERENCE ON RESEARCH AND DEVELOPMENT IN INFORMATION RETRIEVAL, 6 June 1983, pages 3-9,

D2: NUNEZ J L ET AL: "The X-MatchLITE FPGA-based data compressor" EUROMICRO CONFERENCE, 1999. PROCEEDINGS. 25TH MILAN, ITALY 8-10 SEPT. 1999, LOS ALAMITOS, CA, USA,IEEE COMPUT. SOC, US, 8 September 1999, pages 126-132, ISBN: 0-7695-0321-7

D3: EP-A-0 911 738 (CALLUNA TECH LTD) 28 April 1999

D4: WO 01/22425 A (SEAGATE TECHNOLOGY LLC) 29 March 2001

D5: COMPTON, K., HAUCK, S.: "Configurable Computing: A Survey of Systems and Software" TECHNICAL REPORT, NORTHWESTERN UNIVERSITY, DEPT. OF ECE, 1999,

D6: SCHMIT H: "Incremental reconfiguration for pipelined applications" FIELD-PROGRAMMABLE CUSTOM COMPUTING MACHINES, 1997. PROCEEDINGS., THE 5TH ANNUAL IEEE SYMPOSIUM ON NAPA VALLEY, CA, USA 16-18 APRIL 1997, LOS ALAMITOS, CA, USA,IEEE COMPUT. SOC, US, 16 April 1997 (1997-04-16), pages 47-55, ISBN: 0-8186-8159-4

D7: ANONYMOUS: "Method for Allocating Computer Disk Space to a File of Known Size" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 27, no. 10B, 1 March 1985 (1985-03-01), pages 6260-6261,

Re Item II.

Due to the fact that the priority documents were not present at the time of writing this opinion, the content of document D4 could lead to additional objections with regard to novelty and/or inventive step (Articles 33(2) & (3) PCT) of subject-matter, which claims a more recent priority than 07. 04. 2000 (US54547200). These objections are not dealt with in this opinion.

Re Item IV.

The international searching authority is of the opinion that the application does not comply with the requirements of unity of invention as set forth in the PCT regulations Rule 13.2 as the following six inventions are claimed in the present application SA531752 (PCT/US2004/016398), which are not so linked as to form a single general inventive concept (Rule 13.1 PCT):

1. Claims 1-15,17-28, 65-72
   Device and method of manipulating data passing to or from a mass storage medium
2. Claim 16
   A programmable logic device configured to receive in parallel data streams from a plurality of heads belonging to a plurality of disks in a disk system.
3. Claims 29 - 38
   Method for selecting a template for programming a programmable logic device
4. Claims 39 - 64
   Data processing system comprising a plurality of processing stages implemented on a programming logic device
5. Claims 73 - 85
   Data storage medium, method of reading data and disk drive system comprising magnetically stored data for subsequent retrieval by a magnetic head
6. Claims 86 -97
   Method of storing data depending on the file size

This opinion is based on the following reasons:

1. The prior art document D1 discloses a programmable logic device as well as a corresponding method for searching for patterns on a (continuous) data flow, such as characters read from a disk.

   All features of the independent claims 1 & 17 of the application in hand are directly disclosed in the above mentioned document. Claims 2 - 4 also do not contain any technical features, which define a contribution over the prior art, as the search in a decrypted signal, whereby the decryption has been performed by any other means than the programmable logic array, must be regarded as technically equivalent to the method as disclosed in the above mentioned document. The potential special technical features, as defined by Rule 13.2 PCT, of subject 1, not known from the prior art as disclosed by the above mentioned document, can therefore be found in claim 5. and are related to the decryption and decompression of a data stream before performing a search operation.

   The underlying problem of subject 1, solved by the solution proposed in claim 5, can thus be seen as the problem of how to perform a search for patterns in encrypted and compressed data streams using only a programming logic device.

The above mentioned special technical features as defined by Rule 13.2 PCT characterizing subject 1 are merely related to the solution of this specific problem.

2. The potential special technical features of subject 2, not known from the above mentioned prior art, can be found in claim 16. This claim describes a programmable logic device configured to receive a plurality of continuous data streams form a plurality of heads belonging to a plurality of disks in a disk system. This special technical feature solves the problem of accelerating the transmission of data from a disk system to a programmable logic array.

3. The potential special technical features of subject 3, not known from document D1, can be found in claims 29 - 38, wherein a method for selecting a template for programming a programmable logic device is described.

   The special technical features of the third subject, defining a contribution over the above mentioned prior art, are solely related to the selection of a stored template for programming on the bases of determined characteristics. The problem to be solved by these special technical features can be seen as how to improve the programming of a programmable logic device.

4. The potential special technical features of subject 4, also not known from document D1, can be found in claims 39 - 64. This group of claims describes a data processing system comprising a programmable logic device with a plurality of stages implemented as a processing pipeline.

   The potential special features of this subject are merely related to the plurality of processing stages implemented on one programmable logic device, each being dedicated to a different processing operation and the underlying problem can be seen as how to implement multiple operations on a programmable logic device.

5. The potential special technical features of subject 5, which form a contribution over the above mentioned prior art document D1, can be found in claims 73 - 85, which describe a data storage medium, a method of reading data and a disk drive system, all of them related to a rotatable magnetic medium with a plurality discontiguous arcs (special technical feature).

The underlying problem to be solved must be seen as how to improve the construction of magnetic media.

6. The potential special features of subject 6, not known from the above mentioned document D1, can be found in claims 86 - 97. These claims describe a method of storing a data file on a storage medium depending on the file size.

The corresponding potential special features are merely related to the file size dependant storage of the data file, and the underlying problem of the sixth subject can thus be formulated as how to improve the storage of a data file with due regard to its file size.

No same or corresponding special technical features in the claimed inventions within the meaning of Rule 13.2 PCT can be found, therefore no technical relationship between the above described six inventions is present. Hence, the groups of inventions are not so linked as to form a single general inventive concept. As a consequence (see Rule 13.2 PCT), the application does not meet the requirements of Unity of Invention as defined in PCT regulations Rule 13.2, also taking Rule 13.3 into consideration.

The search has been performed on those parts of the international application which relate to the subject-matter of the above mentioned first, the third, fourth and sixth invention (i.e. claims 1-15, 17 - 72, 86 - 97).

Re Item V.

1. First Invention (Claims 1 - 15, 17 - 28, 65 - 72)

1.1 CLAIMS 1, 2 & 17

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 2 & 17 is not new in the sense of Article 33(2) PCT.

Document D1 discloses a programmable logic device (see e.g. page 6, right hand column, lines 25 - 29: "*... based on a simple cell that can be programmed to recognize a single character... These cells are then connected to form arrays ...*") for searching for patterns on a (continuous) data flow from a disk subsystem (see page 5, left hand column, lines 31 - 33:"*The term selector checks the input stream for occurrences of the terms specified in the user's query.*" and further on: "*The term detector can operate at a high bandwidth matching that of the disk, ...*")

In view of these disclosures of document D1, claims 1, 2 & 17 do not fulfill the requirements of Article 33(2) PCT.

1.2 CLAIM 15

The technical features as described in claim 15 seem to be contradictory within the claim, therefore, in order to access novelty and/or inventive step of this claim, it has been interpreted by the examiner in its technically broadest meaning.

The claim states that the device interfaces the mass storage device with a system bus, at the same time the device is in communication with the mass storage device over a computer network. This seems to be a contradictory statement with regard to the technical features of the connection between the device and the mass storage medium, therefore this connection is technically regarded as any suitable sort of local connection between a programmable device and a mass storage medium.

Due to the above mentioned unclarity with regard to the exact technical features of the connection between the device and the mass storage medium, the disclosures of document D1 also render the subject-matter of claim 15 as not new (Lack of Novelty, Article 33(2) PCT).

1.3 CLAIMS 65 & 69

The present application does also not meet the criteria of Article 33(1) PCT, because the subject matter of claims 65 & 69 does not involve an inventive step in the sense of Article 33(3)PCT.

As already mentioned, Document D1, considered to represent the most relevant state of the art to the subject matter of claim 65, discloses a programmable logic device for searching for patterns on a continuous data flow from a disk subsystem.

The subject-matter of independent claim 65 differs from the disclosure of D1 in that the programmable logic device is not used to search for patterns in the continuous data stream, but to perform a compression operation on the received data and to store the compressed data in the data storage medium.

However, using programmable logic arrays, e.g. a FPGA, for compressing data is already known from prior art, see document D2 and has already been employed

for the same purpose (i.e. compression of data) in a similar system. It would therefore be obvious to the person skilled in the art, to either replace or reprogram the programmable logic device accordingly, taken the disclosures of document D2 into consideration, to arrive, without the involvement of any inventive skill, at a system as described in claim 65.

The same argumentation, *mutatis mutandis*, may be used with regard to the lack of inventive step of the subject-matter of claim 69, describing a corresponding device for decompressing data. Hence, claim 69 does not fulfill the requirements of Article 33(3) PCT with regard to the presence of an inventive step, either.

1.4 DEPENDENT CLAIMS 3 - 14, 18 - 28, 66 - 68 & 70 - 72

Dependent claims 3 - 14, 18 - 28, 66 - 68 & 70 - 72 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT) for the following reasons:

- Claims 3 - 6, 8 -11, 19 - 27, 66, 67, 70 & 71 relate to the implementation of an compression / decompression and decryption operation in a programmable logic device. The implementation of various functions, among others the one mentioned above, is already known from prior art, e.g. document D2 (compression / decompression) and document D3 (encryption / decryption). Details about the compression / decompression algorithms used (claims 66, 67, 70, 71) may be regarded as mere implementation details, which the person skilled in the art would add without the need for any inventive skills.

  For the same reasons already given in combination with the discussion of the subject-matter of claims 65 & 69, *mutatis mutandis*, the subject-matter of claims 3 - 6, 8 -11, 19 - 27, 66, 67, 70 & 71 does not contain an inventive step in the sense of Article 33(3) PCT.

- The remaining claims 7, 12 - 14, 18, 28, 68 & 72 refer to subject-matter, which is either general knowledge in the field of programmable logic devices or they refer to additions or implementations, which are obvious for the person skilled in the art. Therefore, these claims also do not fulfill the requirements of Article 33(3) PCT.

2. Third Invention (Claims 29 - 38)

The subject-matter of independent claim 29 relates to a method to select a template defining one or more processing functions, which is loaded into a programmable logic device in order to implement certain processing functions in combination with a mass storage medium.

Document D5 contains a survey of systems and software used in configurable computing, i.e. using programmable logic devices, especially FPGAs. The document clearly describes the technical steps of loading pre-programmed blocks or clusters (i.e. templates) into the hardware (see e.g. page 14, third paragraph - page 15, first paragraph). The use of a floorplanning tool is described, which optimizes the placement of the selected logical blocks to be transferred into the FPGA, each block representing certain processing function. The floorplanning tool is at least considering the desired performance characteristic (page 14, last paragraph: "*Because performance is best when routing is minimized, ...*") and amounts of programmable logic device resources consumed (page 14, fourth paragraph). Additional information about configuring the programmable array can be found on page 18, paragraphs "Partial Evolution" and "Memory Allocation", which disclose further details about the actual selection and placement step for preprogrammed logic functions, to be implemented as blocks (templates) in a corresponding programmable device.

The difference between the disclosures of document D1 and the subject-matter of claim 29 must be seen in the technical environment, in which the programmable device is supposed to be used (claim 29: "... *the programmable device being configured to process data moving to or from the mass storage medium ...*").

However, the technical environment does not have any technical impact on the actual claimed method of selecting a template for the programmable device and does consequently not result in any special technical effect. Therefore, it would be obvious to the person skilled in the art to use the methods of selecting a template for any programmable logic device, as disclosed by document D5, also in combination with a programmable logic device "... *being configured to process data moving to or from the mass storage medium ...*" (claim 29).

The subject-matter of claim 29 does therefore not comprise an inventive step with regard to the content of document D5 (Article 33(3) PCT).

The dependent claims 30 - 38 describe further conditions, which should be taken into account when selecting a template to be transferred into a programmable logic device. These conditions are either disclosed by document D5 or they are obvious conditions for the person skilled in the art in order to maintain or improve a working status of the programmable logic device. It should be noted that a person skilled in the art would not select a certain template to be programmed onto the device if the effect on the processing of the device is known to be negative, e.g. usage of more resources or lowering data throughput.

The subject-matter of claims 30 - 38 does therefore also not comprise an inventive step (Article 33(3) PCT).

3. Fourth Invention (Claims 39 - 64)

3.1 INDEPENDENT CLAIMS 39 & 53

Claim 39 is describing a data processing system including a programmable logic device to process data, wherein the programmable logic device is used to implement a plurality of stages as a processing pipeline, each stage being dedicated to a different processing operation.

The feature of using pipelined processing stages in programmable logic devices is clearly disclosed by document D6, see e.g. paragraph 1.0 "*Introduction*", paragraph 3.0 "*Implementing Pipelined Applications using RTR*" and Figure 2: "*Example Pipelined Application*" as well as by document D5 (page 23: "*Pipeline Reconfigurable*"). Figure 2 of document D6 also shows that each processing stage performs different processing operations (f_1 - f_6) in a pipelined application, using multiple stages corresponding to the different functions (here: high-order FIR filter). The application to be implemented into the programmable logic device has multiple identically-sized pipelined stages, corresponding to the different processing stages of the filter.

The disclosure of D6 leaves doubt whether all pipelined stages are simultaneously implemented on the logic device. Document D5 is disclosing the (partial) reconfiguration of the pipelined stages, each stage is configured as a whole (page 23, paragraph "Pipeline Reconfigurable") and the document clearly discloses the possibility of implementing multiple pipelined stages onto one FPGA (see above mentioned paragraph: "*Either the number of hardware pipeline stages available is greater than or equal to the number of pipeline stages of the desired circuit, ...*".

It must be stated, therefore, that the subject-matter of claim 39 is disclosed by document D6, taking the general teaching of D5 into consideration, and consequently, claim 6 does not fulfill the requirements of Article 33(3) PCT (lack of inventive step).

Claim 53 is referring to a hard disk accelerator, essentially comprising a system as described by claim 39, additionally specifically arranged to process data streams coming from a hard disk drive.

The type of data which is processed by a programmable logic device, e.g the one as described by document D6, does not contribute to the presence of an inventive step in the invention. The use of a programmable logic device to process data streams coming from hard disks is known in the prior art (see e.g. D1), and it is also known from prior art to implement multiple pipelined stages onto a programmable logic device, processing general data (see D6). The use of a programmable device as described by document D6 to process data coming from a hard disk can therefore not be regarded as inventive in the sense of Article 33(3) PCT, and the corresponding system, i.e. the hard disk drive accelerator as described by claim 53, consequently lacks an inventive step.

3.2 DEPENDENT CLAIMS 40 - 52, 54 - 64

The dependent claims 40 - 52 and 54 - 62 are essentially describing different data processing functions, which can be programmed into the programmable logic device as described by claims 39 or 53. The use of these functions (compression, decompression, encryption, decryption, etc.) for processing general data is well known in the prior art. The use of a programmable logic device to perform these functions is also well known in the prior art (see e.g. documents D2, D3), also in combination with a continuous data stream, coming from a mass storage (see e.g. D1). The use of a programmable logic device to perform the well known functions in combination with data streams coming from a mass storage device would therefore be obvious for the person skilled in the art and consequently lead to the systems as described by the above mentioned dependent claims 40 - 52 and 54 - 64.

The subject-matter of claims 40 - 52 and 54 - 64 does therefore not comprise an inventive step in the sense of Article 33(3) PCT.

4. Sixth Invention (Claims 86 - 97)

4.1 INDEPENDENT CLAIMS (86 & 92)

Claim 86 is describing a method of storing a data file of a known size on a storage medium. Depending on the file size, either a single block of storage space or a plurality of blocks of storage space having a certain predetermined size (equal to the power of 2) are requested.

Document D7 discloses a method for allocating computer disk space to a file of known size. In order to minimize loss of storage space due to failure to fill the segments of the disk completely, an efficient algorithm to determine the number and size of memory pages (i.e. storage blocks) needed is disclosed, which is technically corresponding to the method described by claim 86, the only difference being the missing step of explicitly checking whether the file size is an even power of 2 before requesting the blocks of storage space. It is technically not clear from the claim, however, whether this additional step is really meant to be a technically separate processing step of calculating and comparing the binary representation of the file size before any further operation, or whether this step is implicitly included into the subsequent step of requesting the needed plurality of storage blocks from the storage device, which is disclosed by D7.

However, even the explicit addition of this processing step to the method as disclosed by D7 does not result in any unexpected effect, and the examiner can not determine any problem, which is solved by this additional processing step. The technical effect of the method as disclosed by D7 and the method of claim 86 is identical.

The subject-matter of claim 86 does therefore not fulfill the requirements of Article 33(3) PCT (lack of inventive step).

The subject-matter of claim 92, as far as it can be understood due to a lack of clarity (Article 6 PCT), seems to be corresponding to the method as described by claim 86, additionally maintaining a minimum block size for the blocks of storage space on the storage medium and eventually rounding the requested number of storage space to a power of 2 (i.e. 2^m).

Again, it must be stated that it is not clear from the claims whether the described steps of calculating and comparing the file size are in fact separately performed

processing steps, and which problem is solved by the addition of these processing steps.

However, even the explicit addition of these processing step to the method as disclosed by D7 does not result in any unexpected technical effect, solving a potentially present problem, which the examiner is not able to not determine. The technical effect of the method as disclosed by D7 and the method of claim 92 is identical and the rounding process for files smaller than a certain size (i.e. 2^m) is equally disclosed by document D7.

The subject-matter of claim 92 does therefore also not fulfill the requirements of Article 33(3) PCT (lack of inventive step).

4.2 DEPENDENT CLAIMS (87 - 91, 93 - 97)

The subject-matter of claims 87 and 93 is highly unclear (Article 6 PCT), however, it seems to relate to the method of calculating the necessary requested block size out of a binary representation of the known file size, as described by document D7, second paragraph.

The subject-matter of claims 88 - 91 and 94 - 97 must be seen as generally known methods in the field of file systems and memory allocation on mass storage devices, the addition of which to the subject-matter of any claim, on which the corresponding claims depend, would be obvious to the person skilled in the art.

The subject-matter of claims 87 - 91 and 93 - 97 does therefore also not fulfill the requirements of Article 33(3) PCT (lack of inventive step).